

I am convinced, that Italy was a chain of volcanos, of which we know only some of the links. I have found lavas exactly like that of Vesuvius in the whole way from Florence to Naples, and in places, where there was not any suspicion of volcanos. All the lakes of Italy, which I have seen hitherto, exhibit traces, not to say evidences, of this.

I begin to think, that the whole earth is perhaps in the same case with its surface, and was thrown into the utmost disorder at some period of time, of which no remembrance has been preserved. Lazzaro Moro, a Venetian, has gone much farther than I do: all the mountains, isles, and continents arose, according to him, from the bottom of the sea, by means of subterraneous fires. I never heard of his opinion till after I had formed my own conjecture, or rather verified the fact in part of the Apennine, which I have passed through. I have had time only to run over the titles of his chapters.

CIV. *Observations upon the Currents of the Sea, at the Antilles of America: By Dr. Peyssonnel, F. R. S.*

Read May 6, 1756. **T**HE coasts of these American islands are subject to counter-tides, or extraordinary currents, which render it very dangerous to chaloupes and other small craft to land; whilst, at the same time, the boats and ships in the roads are scarce ever sensible of them, and seldom incommoded by

by them ; nor do those, which are out at sea, appear to be affected by them. It is however, certain, that a regular wind constantly blows, in these parts of the of the torrid zone, from the tropic of cancer, to the equinoctial line, from the east ; inclining sometimes northward and sometimes southward. This wind is called * Alizé, for reasons admitted by philosophers, and drives the waters westward, giving a total and uniform course to that immense quantity, which comes from the great river of the Amazons, and from an infinite number of other rivers, which discharge themselves into the ocean. These currents passing to the westward, go up to the American islands, then to the coasts of Jucatan and Mexico, and running round in the gulph, return into the great ocean, by the straits of Bahama, along the coasts of Florida, in order to pursue, in the north, the course ordained them by the Supreme Being. It is in this course the waters are known to run with an extraordinary rapidity ; they pass between the great and little islands of America, in the great deeps, by an almost even and imperceptible motion ; but against the shores and coasts of these islands, which form this archipelago, these currents are very sensible and dangerous ; they interrupt the navigation, insomuch that it is scarce possible to stem these tides to get to the eastward. I remember that in 1711, being in the bay of la Guade, a point to the west of Portorico, it was impossible for us to get up to the town of St. John de Portorico, whither we were conduct-

* Trade Winds.

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ing the bishop of that town, whom we took on board at the Havanna in the island of Cuba : we spent thirty days in making thirty leagues ; the night was calm, and then we lost what we had gained by day ; and whether we made long or short tacks, the currents drove us to the westward. It often happens, that vessels steering from St. Domingo, or the other Lee-ward Islands, to the Windward ones, cannot absolutely accomplish it, and are therefore obliged to get out of the channel, and steer away to the northward, in order to tack up to the Windward Isles. These are daily observations, and well known to all navigators of America.

Besides these regular currents, there are others, which are called counter-tides, which are observable upon the sea-coasts and shores. In places, where these flow, the sea rises in an extraordinary manner, becoming very furious without any apparent cause, and without being moved by any wind ; the waves rise and open very high, and break against the shore, with such violence, that it is impossible for vessels to land.

It is observable, that these sorts of tides, which sometimes last several days, and at other times spend their violence in twenty-four hours, are more frequent in what they call the bad season, which is from the month of July to November, than at any other time of the year : and that, in these months, tempests and hurricanes happen, which throw down and destroy the houses, buildings and plantations of these colonies. I have gone through several of these tempests or hurricanes ; the first in 1712, when I was at sea, along the coast of the island of Clerave or Bouriquen, to the

the south east of Portorico ; the others in the island of Guadaloupe and the Grande Terre. The most furious were those, which happened August 29, 1738, and the 8th of September, 1740, of which I can speak to my own knowledge ; and perhaps it may not be disagreeable to hear a description of them, which will lead me to my system, or at least to support my conjectures of the cause of these sea-currents.

Hurricanes are foreseen by a calm, and a frequent shifting of breezes from all points ; the setting sun of a blood-red ; little clouds moving with great rapidity ; the sea-birds, called frigates, and many other kinds, quit the air, and seek the shore. By these signs, together with the season, in which these happen, the hurricanes are expected ; proper precautions are then taken to avoid the fury of the winds ; the houses are propped, the windows and doors are barred up, and papers and other valuable moveables are secured in chests.

Soon after, a north breeze springs up, which comes to the north-east, and from south to south-east ; the air is darkened by one continued thick cloud, which increases the horrors of the night ; for it often happens, that these tempests come in the night, and continue all the next day. In the last hurricane, I saw the wind stood at north-east, and blew with such violence, that the largest trees were torn up by the roots, their trunks broken to pieces ; nor was there a leaf left upon those other trees, which yielded to the fury of the winds ; the houses were thrown down, and the tops of the sugar-mills, which are conical, and less susceptible of being thrown down, were crushed

to pieces ; scarce any thing remained standing upon the ground. These furious winds were accompanied with a violent rain, which resembled the mist made by the agitation of waves, or like waters kept up by the wind. The tempest lasts till day-light, and sometimes continues pretty far in the day. In that in 1740, towards eight o'clock in the morning, it grew suddenly calm for a quarter of an hour, and then returned again blowing from the south, with such violence, that the buildings and trees, which were destroyed by the north wind before, were blown about, and moved by the first blast of that from the south. The hurricanes were followed by so many particular and surprising phænomena, which were almost incredible, that I dare not report them : however, a philosopher, who is acquainted with the force and power of confined air and its elasticity, might admit them to be true. At the end of these, there appears lightening, and we can hear the noise of thunder : these are the signs of the tempest's being at an end ; for the wind softens gradually, and all becomes quiet.

After these hurricanes the forests appeared only like a parcel of ship-masts or poles standing ; all the trees being stript of their leaves, and their branches broken off made a dreadful appearance, especially in these countries, where a perpetual verdure adorns the trees and fields. Every one was employed in repairing his losses, and mending the dismal remains of the frightful wreck.

In 1743, two years after the great hurricane, we had a storm less violent than the two former. I happened

pened to be from home ; and, when the violence of it was over, I turned out to return to my house, to repair such losses as I expected to have sustained ; and, in my road, I came upon a rising ground from whence I viewed the island of Guadaloupe, being then upon the Grande Terre of this island.

I observed, that the storm, which had affected us in the night, was now very violent upon the island of Guadaloupe : it was a frightful, thick, black, cloud, and seemed on fire, and gravitating towards the earth : it occupied a space of about five or six leagues in front ; and above it the air was almost clear, there appearing only a kind of mist.

I then knew, that, in order to be acquainted with the whole force of a hurricane, it must be found in the very body of a cloud ; that is, we commonly find the effects by the impressions made on us, whether by winds, rains, lightening, or thunder, from it. It is from the elements in it these effects are produced, where the wind or air is compressed, and rolling upon itself, causes the storms, which overthrow every-thing. He is unhappy, who happens to be in the stream of this fluid ; for the most solid buildings tumble down ; whilst the villages of little huts of the negroes stand unhurt ; because they are not met by the current of wind. Judge what must be the violence of these hurricanes, when a piece of timber of a mill thirty-two inches square by thirteen feet long, which might weigh eight or ten thousand pounds, was thrown several paces from its place by one of these hurricanes.

It is in the clouds these elements, water, air, and fire, produce their effects. The water is, as it were,

suspended by the wind, and fiery places appear in them, which are neither lightening, *ignis fatuus*, nor *phosphorus*; nor does the hurricane end, till the cloud bursts, and the lightening and thunder come on; nor do the impressions made by the mixture and strife of all these elements blended together, cease till then.

This episode, far from leading me from my subject, which regards the cause of currents and counter-tides, is what naturally brings me to it. These clouds, bearing downwards from on high upon the surface, form a kind of solid, which compresses the water perpendicularly, and forces it against the bottom. This impulse, made against the solid earth below, acts chiefly upon the shores according to this motion; then the sea is subject to two impressions, one upon the surface from the storm that agitates it, and the other from the weight and total pressure of the cloud that lies over it: this causes the waters to circulate at the bottom, giving them a particular motion along the coasts, which is not perceivable at a certain distance from them. According to the direction of the storm, whether east, west, north, or south, of an island; and according to whatever point of the island presents to the impulse of the wind, the waters separate, their motion is now in two directions, the current is observed to go on one side of the island to the east, on the other, to the north; and, on the contrary, the one to the west, and the other to the south; and that depends upon the position of the island, according as it resists the total motion of the waters at the bottom of the sea. Nor have these counter-tides any regular or determined course.

I observed, that, whenever we had storms or hurricanes at Guadaloupe, the counter-tides were very violent at Martinico and the neighbouring islands; and even in the road of St. Pierre the vessels, that were moored too near the shore, were dashed to pieces: and in 1750, when the island of St. Eustace was so ruined by a dreadful hurricane coming in a contrary course, on the 1st of November, we had here the most violent counter-tides.

This is the description of one of the most extraordinary phænomena; and, I think, it is the greatest counter-tide, that has been heard of. On the third of July, 1746, a very strong current, or counter-tide, was observed to the windward of this island, Grande Terre, Guadaloupe, which came from the island of La Desirade; that is, from the east. It was first perceived about the mole; the waves broke in, sinking some of the pallisadoes of the houses, and tumbling others down; but its greatest violence appeared about eight leagues from that along the steep coast; for from the mole, the shore is a strait precipice of above two hundred feet high. The sea was so dreadful, that it rose up, and threw sand over the precipice upon the plain. I never could have believed it possible, if I had not seen it myself, when I was some months after at the Caribbees, which are along this coast to the northward of this island, Grande Terre, Guadaloupe, in places where the sea, driven by the common winds, is always in agitation. This coast, where the savages have a retiring place, is formed by such precipices of two or three hundred feet high, and being so plumb steep, is a frightful sight, which way soever it is viewed. Above

the precipices the sea looks like a deep abyss ; the rocks escape the sight below ; and, when viewed from below, these precipices seem to be in the clouds, and their tops over-head look, as if they would fall upon, and crush one to pieces every moment. The dread of the earth's failing terrifies those above ; and the fear and apprehension of the rocks tumbling upon one frights those below ; and yet, notwithstanding all that, the savages go ashore in these places, leaving their barks in little creeks, which they find below ; and climb these precipices, where goats and kids can scarce keep their footing ; and that with an incredible courage and dexterity.

The place in the Caribbees we went to see was agreeable enough, though wild and desert. We could not see from thence La Desirade, St. Domingue, Guadaloupe, and Les Saints ; our view extended over the land of this island, which was very low ; and the sea to the northward presented to us the English islands Montserrat, Antigua, Nevis, &c. The trade wind refreshed the air ; and some trees defended us from the rays of the sun. It was here we beheld what was almost incomprehensible ; and what I never could have believed, if I had not seen it. We found a vast quantity of sand thrown up by the sea from the counter tide, of which I am treating : The sea was so agitated, and was raised so high, that it passed over the bounds, that God had set it in this island. 1. The waves rose along this coast to two hundred and forty feet high, bringing with them the sand mentioned. 2. The current continuing its course and violence tore away the largest trees by the roots along the coasts, and threw up a prodigious quantity

quantity of madrepores. In the more low places, towards Port Louis, Pointe d'Antique, it run more than a thousand paces within land. Here I must stop, not daring to declare the end of this tide, for fear of being disbelieved ; because I do not myself comprehend how what I saw could happen, nor imagine the cause. What I am to tell you shocks good sense and reason, although it is the real truth.

It must be observed, that there is a grand bay or gulph in this place formed by the point called Dantique Isle Grandterre, and the point of the old fort Isle Guadaloupe, and by the little island called Ca-houane ; these two points are seven or eight leagues distance from each other ; the bay being much of the same length, extends inwards as many leagues to the salt river, or natural canal of sea-water, which separates the two islands. There are several small islands in the middle of this gulph ; and the coasts all round are very low. Between Lance Bertrand and Port Louis, there is a marsh made by the rain waters, which are confined there by a bank of stones and sand, which separates the lake from the sea ; and the waters of the marsh naturally run towards Port Louis, and partly towards the Pointe d'Antique : so that if Port Louis is not lower, it is at least upon the level.

The waters of the counter tide forced this bar or sand-bank into the marsh, and rushed up to the main land, near two thousand paces from the sea-shore : they must have risen at least ten or twelve feet above the surface of the sea. The natural course of these waters was therefore to descend towards Port Louis ; but this was not the case : these same waters, which

were

were so violently driven by the counter tide, instead of passing out by the natural common way, rushed back upon themselves, and returned into the sea, by the same road they had formed for their entrance; and not a drop of these waters passed to Port Louis. This Pointe d'Antique was always the *ne plus ultra* of the counter tide, as well by sea as by land. I was at five o'clock that afternoon in the town of Port Louis, and we could perceive no manner of alteration in the sea. They informed us of the terrible havock made by the counter tide, above the Pointe d'Antique, about a thousand or fifteen hundred paces from the town. I ran away towards the place, but was stopped by the waters, and trees that were torn up, which blocked up the way. The more I consider this phænomenon upon these places, the less I understand it. The counter tide having finished its course, and produced these effects, the waters were driven to the islands in the middle of the bay, and they were covered with the overflowing waters for several days. After all this, let mankind endeavour to find a reason for these effects of nature. These are the observations, which, joined to many others, may lead to a general system for explaining the currents of the sea.

Observations upon certain Currents in the Mediterranean Sea.

If the knowledge of the flux and reflux of tides is of so much importance to navigation, an acquaintance with the currents will appear of no less consequence. There are currents known to be so rapid, that

that, notwithstanding the wind, they are not to be stemmed; such as the channel of Bahama in Florida, and some others. But there is no certain regulation for those other currents, which happen in the straits along the coasts, and even at sea. There are scarce any means found out to observe them; nor have there as yet been any researches made after the causes; nor indeed have any applied themselves to observe their exact variations. I do not doubt, but that great advances would be made in the knowledge of the subject, if a considerable number of observations were collected, and compared together; and that the coming of those currents, and even their duration might be foreseen. The following is what I have observed, which I produce in order to be joined to such as may be made hereafter.

Observations made at Bizerty, in Barbary, in the year 1724.

In the voyage I made into Barbary by the king's order, I was at Bizerty, formerly called Hippozaritos: this town is situated on the northern coast of Barbary, in the kingdom of Tunis, within four leagues west of the gulph of Carthage, bearing north and south with Cape Carbonaire in the island of Sardinia, and in 37 degrees 18 minutes north latitude.

Before this little town the sea forms a small gulph, being about a league north and south, by three leagues east and west. The town was built at the end of this gulph, upon a canal, which ends in a large pond or lake, which extends southward and westward; three leagues long and as many broad. At the end of this

there

there is a second canal, upon which the town called Thimida was formerly built: this canal is about a quarter of a league long, and communicates with a second pond something less than the former. I cannot find a reason why (according to Mons. De Lifle, in the chart for the consideration of the council), this pond should be called *Lacus Dulcis*; for they both are salt water notwithstanding, and nourish a great quantity of sea-fish; such, among others, as the mullet, the roe of which they call, when it is dry, by the name of *boutarque* *.

I had heard, that there were considerable currents in these lakes; and when we arrived at Bizerty, I saw the waters run out of the lake with so extraordinary a rapidity, that I took it for a river: but, upon recollecting what was told me, I observed, that the wind was then at E. N. E. that the waters ran out for eight days with this wind; and the lake sunk a foot and half by the observations I made on one of the piers of the bridge upon this canal. The wind then changed, and came about to the west, and the water returned with the same rapidity that it had run out before. I even perceived on the bank, or fence, made by the reeds, that the waters of the sea were four inches higher than those of the lake; and rose while the westerly wind blew. Some days after the winds shifted; and I saw on the same

* Dr. Shaw (in his travels, pag. 155.) describes the lake of Tunis; and says, it is famous for affording a fine prospect; receiving no small beauty from the many flocks of the *Flamant*, or *Phoenicopterus*, that frequent it: and that it is no less famous for its large Sweet Mullets; the roe of these dried is a delicacy, and called *Botargo*.

day, the waters pass in, and out, according as the wind blew east or west.

The inhabitants assured me, that this phænomenon never happened but sometimes in winter ; and that the rain-water runs out of the lake, when it is full, even though the wind be west. Now it may be concluded from these observations, that the winds contribute very much to the currents of the Mediterranean Sea ; since they appear to be the efficient cause of those I have described.

Observations at Marseilles.

It is observed regularly at the port of Marseilles, that, when the winds are to the south-west, the waters are up ; that is, that the waters rise considerably upon the shore, and the quay of the port : and that, when they are to the north-west, the waters, on the contrary, are very low. This second daily observation concurs with the former to prove, that the winds may be the cause of the currents.

But as common matters are passed over with contempt, frequent observations, which may be very quick, are neglected, and people are more ready to attend to what is more singular ; such as the extraordinary flow, that happened at the port of Marseilles, on the 29th of June, 1725, when the waters rose over the quay, and into the shops ; and as suddenly retired. The philosophers of that place mention it. But I did not see it myself ; but I shall describe an inundation very like this, which happened at Bonne in Barbary, which I saw, on the fourth of the same month, and the same year.

Observations at Bonne (called also Hipone) in Barbary.

On that day, the weather was very changeable; it rained in the afternoon; and the wind came to the South-west: ateleven o'clock at night it became calm, and the sea was quiet. I was upon the terras of the India company's house half an hour before sun-set; and we observed, that the waters were very high; when all on a sudden an extraordinary current happened; and, in less than a minute, the sea-waters retired swiftly, and sunk ten feet and upwards; the sea-shore became dry more than two hundred paces from its common mark, leaving the fish upon dry land, numbers of which were taken up; and among others a kind of raii, which weighed thirty pounds.

Three minutes after, the waters entered again with the same rapidity, with which they ran out; and I observed even till night, that those irregular motions of the sea diminished by degrees; and that, about every two minutes, the waters went in and out alternately, losing their motion insensibly, like those undulations made by agitating a vessel of water, which gradually become less by turns.

My reflections upon these observations would be unnecessary. I should however add here, what the coral-fishers told me, and made me observe, on holding the cord of the machine, which they cast into the sea for fishing. They observe, that there are often currents upon the water, which carry their boats to one side; whilst at the bottom of the sea, there is a contrary current to that upon the surface; and that, if they are not expert in making proper remarks, they often lose

lose their fishing ; casting their nets to little purpose, which being carried away by the current, do not fall where they intend for finding the coral.

XCV. *An Account of Lacerta (Crocodilus) ventre marsupio donato, faucibus Merganferis rostrum æmulantibus. By Mr. George Edwards, Librarian to the College of Physicians.*

Read May 6, 1756. THREE of these Crocodiles were sent over from Bengal about ten years ago to the late Dr. Mead, physician in ordinary to the King ; two of which he preserved in his own collection, and presented the third to the late curious Mrs. Kennon ; and since the decease of these eminently worthy persons, they are all become the property of Mr. James Leman, of London, who has obliged me with the use of one of them to produce, together with this account, to the inspection of the Royal Society ; which is the subject here laid before you ; and of which I present the Society with a figure, just of the size and form it appeared in, when taken out of the spirits (Tab. xxix.). I suppose this not to have been many days excluded from its egg, when taken. My reason for this conjecture is, because the nails or claws on the outer toes do not yet appear ; which, I suppose, may be inconvenient, or at least useless, while it is inclosed in the egg ; which, by its struggles, might tear its membranous covering before